



SAMSUNG DISPLAY

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Product Information

Customer : AV Concept

DATE : 04. Sep. 2012

SAMSUNG TFT-LCD**MODEL : LTA320AP33****Suffix : 001**

** When Maturity change on MP , Suffix code will be revised.

The information described in this specification is preliminary and can be changed without prior notice

Samsung Display Co . , LTD.

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Contents

Revision history	(3)
General description	(4)
General information	(4)
1. Absolute maximum ratings	(5)
2. Optical characteristics	(6)
3. Electrical characteristics	(9)
3.1 TFT LCD module part	
3.2 Back light unit part	
4. Input terminal pin assignment	(12)
4.1 Input signal & power	
4.2 LED Bar connector	
4.3 LVDS interface	
4.4 Input signals, basic display colors and gray scale of each color	
5. Interface timing	(17)
5.1 Timing parameters	
5.2 LVDS Input data characteristics	
5.3 3D mode sequence	
5.4 Timing diagrams of interface signal	
5.5 Power ON/OFF sequence	
6. Outline dimension	(20)
7. Packing	(22)
8.1 Carton (Internal package)	
8.2 Packing specification	
8. Marking & Others	(23)
9. General precaution	(24)
9.1 Handling	
9.2 Storage	
9.3 Operation	
9.4 Operation condition guide	
9.5 Others	

*** Revision History****Samsung Secret**

Date	Rev. No	Page	Summary
04. Sep. 2012	000		First issued

www.panlook.com

General Description

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Description

LTA320AP33 is a color active matrix liquid crystal display (LCD) that uses amorphous silicon TFT(Thin Film Transistor) as switching components. This model is composed of a TFT LCD panel, a driver circuit and a back light unit.

The resolution of a 32.0" is 1366 x 768 and this model can display up to 16.7million colors with wide viewing angle of 178° or higher in all directions. This panel is intended to support applications to provide a excellent performance for Flat Panel Display such as Home-alone multimedia TFT-LCD TV and high definition TV

Features

- RoHS compliance (Pb-free)
- High contrast ratio & aperture ratio with wide color gamut
- SPVA(Super Patterned Vertical Align) mode
- Wide viewing angle (typ.178°)
- High speed response
- HD resolution (16:9)
- Low Power consumption
- Direct Type LED (Light Emitted Diode) BLU
- DE (Data Enable) mode
- 1ch LVDS (Low Voltage Differential Signaling) interface (1pixel/clock)

General Information

Items	Specification	Unit	Note
Module Size	724.5 (H _{Typ}) x 424.3 (V _{Typ})	Mm	±1.0mm
	37 (D _{Max})		
Weight	3800 (Typ.)	g	
Pixel Pitch	0.51075 (H) × 0.17025 (V)	mm	
Active Display Area	697.6845 (H) X 392.256 (V)	mm	
Surface Treatment	Anti-Glare Haze 14%, Hard coating (2H)	-	
Display Colors	8 bit – 16.7 M	color	
Number of Pixels	1366 x 768	pixel	
Pixel Arrangement	RGB Horizontal stripe		
Display Mode	Normally Black		
Luminance of White	300 (Typ.)	cd/m ²	

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1. Absolute Maximum Ratings

If the condition exceeds maximum ratings, it can cause malfunction or unrecoverable damage to the device.

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	V_{DD}	GND-0.3	13.2	V	(1)
Storage temperature	T_{STG}	-20	60	°C	(2)
Operating temperature	T_{OPR}	0	50	°C	
Surface temperature	T_{SUR}	0	65	°C	(3)
Shock (non - operating)	X,Y,Z	-	50	G	(4)
Vibration (non - operating)	V_{NOP}	-	1.5	G	(5)

Note (1) $T_a = 25 \pm 2$ °C

(2) Temperature and relative humidity range are shown in the figure below.

- a. $T_a \leq 39$ °C , Relative Humidity is max 90 %
- b. $T_a > 39$ °C , Relative Humidity is less than 90%
- c. No condensation

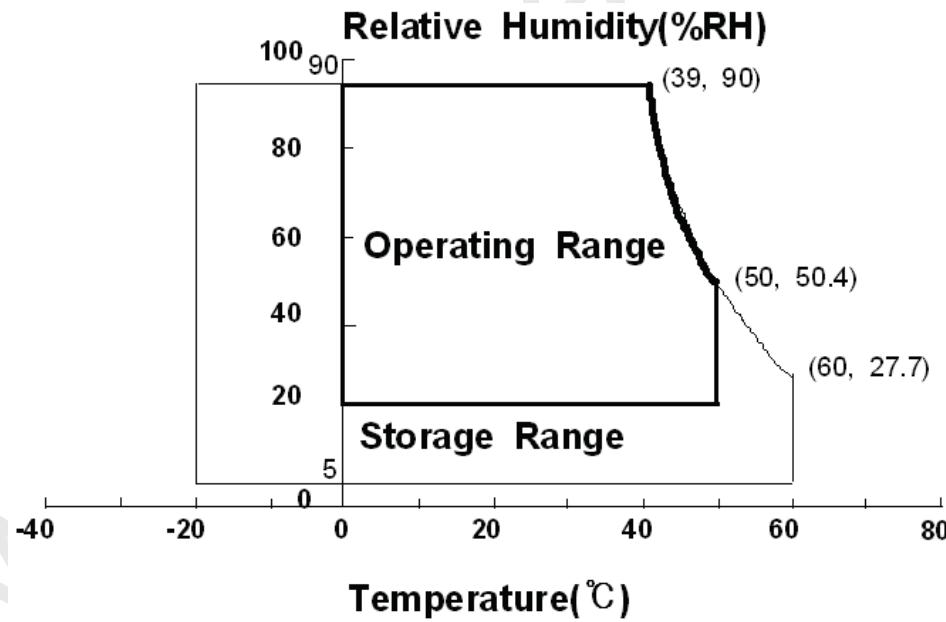


Fig. Temperature and Relative humidity range

(3) Although abnormal visual problems can be occurred in T_{SUR} range, the polarizer is not damaged in this range.

(4) 11ms, sine wave, one time for $\pm X, \pm Y, \pm Z$ axis

(5) 10-300 Hz, Sweep rate 10min, 30min for X,Y,Z axis

2. Optical Characteristics

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The optical characteristics should be measured in a dark room or equivalent condition.

Measuring equipment () : equipment maker

: BM-7(TOPCON), PR-650(Photo Research), SR3(TOP CON)

($T_a = 25 \pm 2^\circ C$, $VDD=12V$, $f_v= 60Hz$, $f_{DCLK} = 78 MHz$, $If = 400mA$, Dim.duty 100%)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)	C/R			-	3000	-		(1) SR-3
Response Time (2D)	T _g			-	20	30	msec	(3) BM-7, RD-80S
Luminance of White (Center of screen)	Y _L			260	300	-	cd/m ²	(4) SR-3
Color Chromaticity (CIE 1931)	Red Green Blue White	Rx Ry Gx Gy Bx By Wx Wy	Normal $\theta_{L,R} = 0$ $\theta_{U,D} = 0$ Viewing Angle	0.640 0.337 0.327 0.616 0.146 0.054 0.275 0.285	TYP - 0.030	TYP + 0.030		(5),(6) PR650, SR-3 Center Point
Color Gamut	-			66	70	-	%	(5) SR-3
Color Temperature	-			-	11,000	-	K	
Typ. Viewing Angle	Hor. Ver.	θ_L θ_R θ_U θ_D	C/R ≥ 10	75 75 75 75	89 89 89 89	- - - -	Degree	(6) EZ-Contrast
White Brightness Uniformity (9 Points)	B _{uni}			-	-	30	%	(2) SR-3

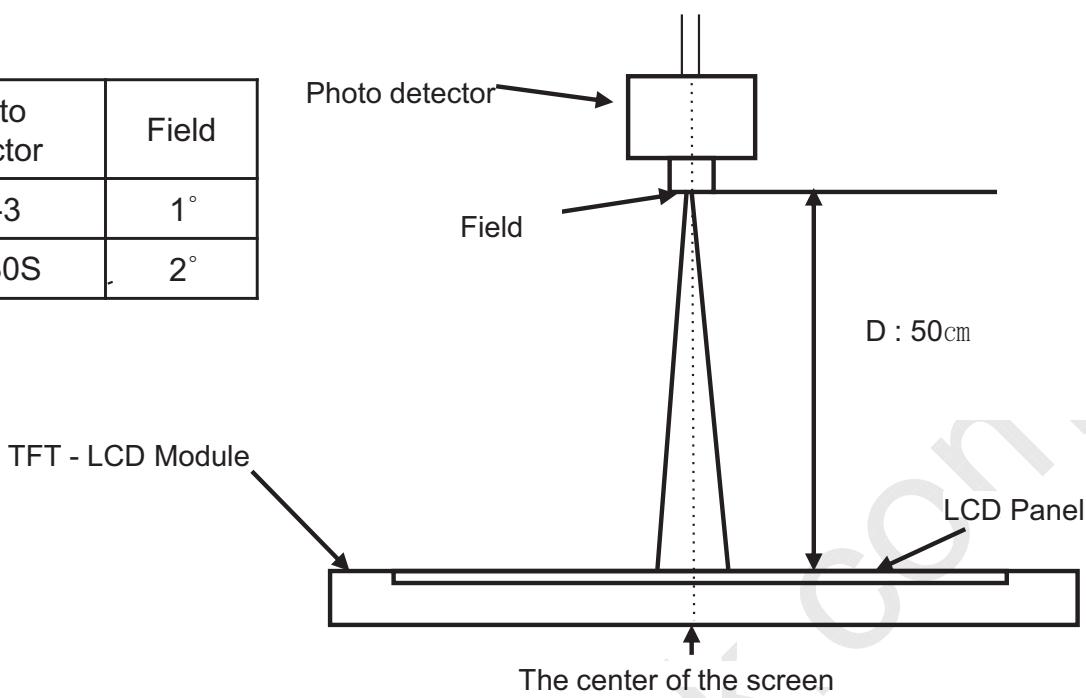
- Test Equipment Setup

The measurement should be executed in a stable, windless and dark room between 40min and 60min after lighting the back light at the given temperature for stabilization of the back light. This should be measured in the center of screen.

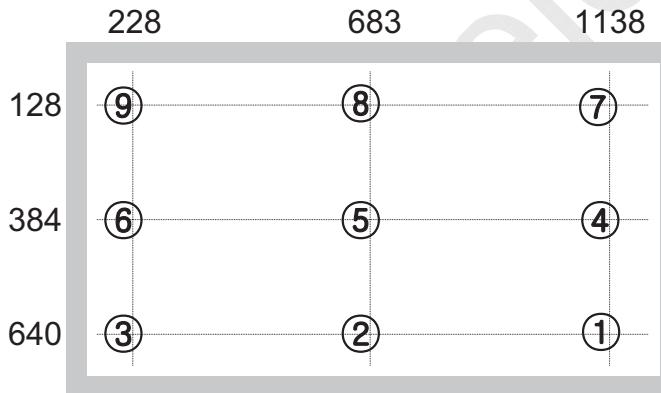
Environment condition : $T_a = 25 \pm 2^\circ C$

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Photo detector	Field
SR-3	1°
RD-80S	2°



- Definition of test point



Active Area

○ Test Point

Note (1) Definition of Contrast Ratio (C/R)

: Ratio of gray max (Gmax) & gray min (Gmin) at the center point ⑤ of the panel

$$C/R = \frac{G_{\max}}{G_{\min}}$$

Gmax : Luminance with all pixels white

Gmin : Luminance with all pixels black

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Note (2) Definition of 9 points brightness uniformity (Test pattern : Full White)

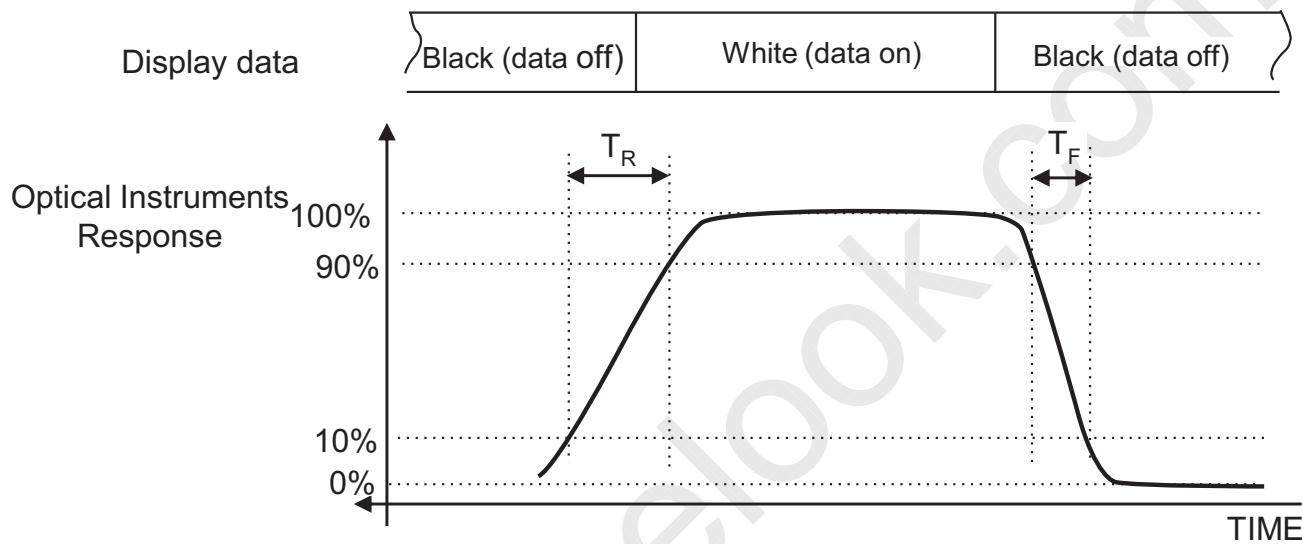
$$B_{uni} = 100 * \frac{(B_{max} - B_{min})}{B_{max}}$$

Bmax : Maximum brightness

Bmin : Minimum brightness

Note (3) Definition of Response time : Average of T_R , T_F

(data is 8 x 8 Gray table, excluding 0 to 255Gray)



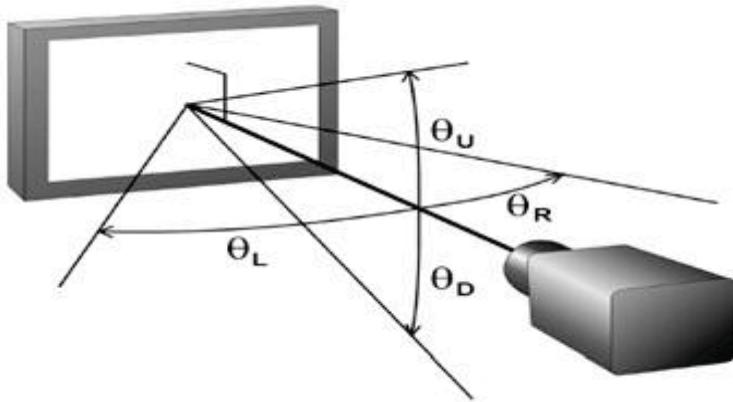
Note (4) Definition of Luminance of White : Luminance of white at center point ⑤

Note (5) Definition of Color Chromaticity (CIE 1931)

Color coordinate of Red, Green, Blue & White at center point ⑤

Note (6) Definition of Viewing Angle at center point

: Viewing angle range ($C/R \geq 10$)



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3. Electrical Characteristics

3.1 TFT LCD Module

The connector for display data & timing signal should be connected.

$T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply	V_{DD}	10.8	12.0	13.2	V	(1)
(a) Black	I_{DD}	-	330	420	mA	(2),(3)
		-	360	440	mA	
		-	490	620	mA	
Vsync Frequency	f_V	47	60	66	Hz	
Hsync Frequency	f_H	44	48	53	kHz	
Main Frequency	f_{DCLK}	72	78	85	MHz	
Rush Current	I_{RUSH}	-	-	3	A	(4)

Note (1) The ripple voltage should be controlled under 10% of V_{DD} .

(2) $f_V=60\text{Hz}$, $f_{DCLK} = 78\text{MHz}$, $V_{DD} = 12.0\text{V}$, DC Current.

(3) Power dissipation check pattern (LCD Module only)

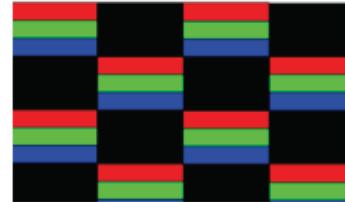
a) Black Pattern



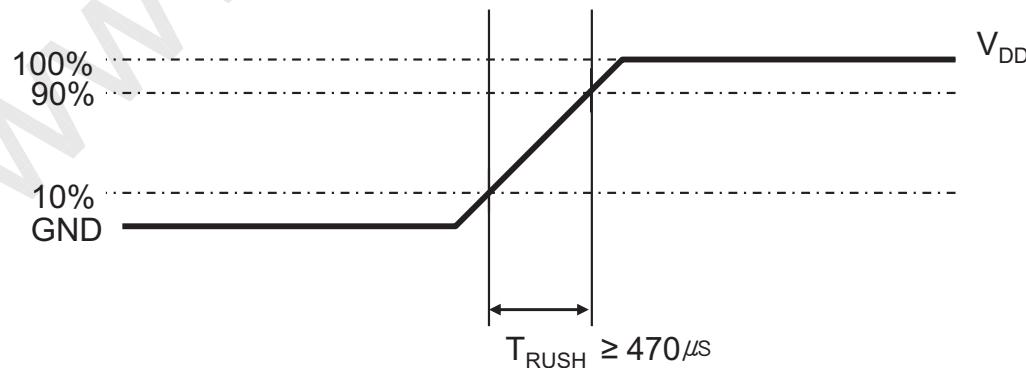
b) White Pattern



c) checker



(4) Measurement Conditions



Rush Current I_{RUSH} can be measured when T_{RUSH} is bigger than 470 μs .

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3.2 Back Light Unit

The back light unit contains Direct type White LEDs (Light Emitting Diode)

T_a=25 ± 2°C

LCD Module

Converter CNT

Signal & Power CNT

Item	Min.	Typ.	Max.	Unit	Note
Operating Life Time	30000	-	-	Hour	T _j = 133°C (1)

Note (1) It is defined as the time to take until the brightness reduces to 50% of its original value.

[Operating condition : T_a = 25±2°C]

3.3 Converter Input Condition & Specification

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Items	Symbol	Conditions	Specifications			Unit	Note
			Min.	Typ.	Max.		
Input Voltage	V _{in}	-	22	24	26	V	T _a =25±2 °C
Input Current	I _{in_overshoot}	V _{in} = 24V, Dim=3.3V (Within 1hr at BLU on)	-	1.36	1.4	A	
	I _{in_saturation}	V _{in} = 24V, Dim=3.3V (After 1hr Aging)	-	1.35	1.39	A	
Input Rush Current	I _{RUSH}	V _{in} =24.0V V _{dim} =3.3V	-	-	1.7	A	
Backlight On/Off	ON	V _{in} =24.0 V	2.5	-	5.25	V	Pin(#12)
	OFF	V _{in} =24.0 V	0	-	0.4		
Dimming Range	V _{DIM}	V _{in} :22~26V	0	-	3.3	V	
Dimming Duty Output	D max	V _{in} =24V Dim:3.3V	-	-	100	%	(2)
	D min	V _{in} =24V Dim:0V	10	-	-		
Dimming Frequency	F _{PWM}	V _{in} =24.0 V	-	-	-	Hz	Analog, (2)
External Dimming Duty Range	EX_Dim	Min	10	-	100	%	
External Dimming Frequency Range	F _{EX_PWM}	V _{in} =22.0~26.0 V	-	100/120	-	Hz	Dim Pin(#14) : Floating, (4)
External Dimming Signal Level	V _{PWM}	High (ON)	2.5	-	5.25	V	
		Low (Off)	0	-	0.4		

Note) Power Consumption is measured when 300 [cd/m²] of luminance which is the typical luminance.

(1) All data is measured after 60min warm-up.

(2) only use #Pin 13

(3) only use #Pin14

(4) External PWM frequency should be synchronized with SET frequency

4. Input Terminal Pin Assignment

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4.1. Input Signal & Power

Connector :IS100-L300-C23(UJU)

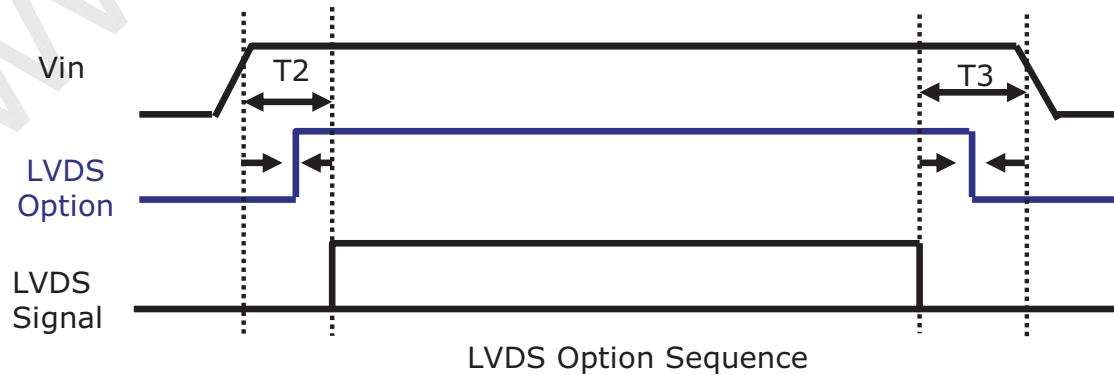
PIN No.	Description	PIN No.	Description
1	VIN (12V)	16	LV1_P
2	VIN (12V)	17	GND
3	VIN (12V)	18	LV2_N
4	VIN (12V)	19	LV2_P
5	N.C	20	GND
6	GND	21	LVCLK_N
7	GND	22	LVCLK_P
8	N.C	23	GND
9	LVDS_SEL (note 2, 3)	24	LV3_N
10	N.C	25	LV3_P
11	GND	26	GND
12	LV0_N	27	N.C
13	LV0_P	28	N.C
14	GND	29	N.C
15	LV1_N	30	GND

Note1) No Connection: This PINS are only used ONLY for SAMSUNG.

Note2) LVDS OPTION : If this PIN is HIGH (3.3 V) → Normal LVDS format
LOW (GND) → JEIDA LVDS format

Pull down resistor : 47Kohm

SEQUENCE : On = $V_{DD} \geq$ LVDS Option \geq Interface Signal(T2)
OFF = Interface Signal(T3) \geq LVDS Option



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Note 3) Signal level of LVDS selection

	Min	Typ	Max
High	2.8V	-	3.6 V
Low	0 V	-	0.4V

Note4) Pin number starts from right side

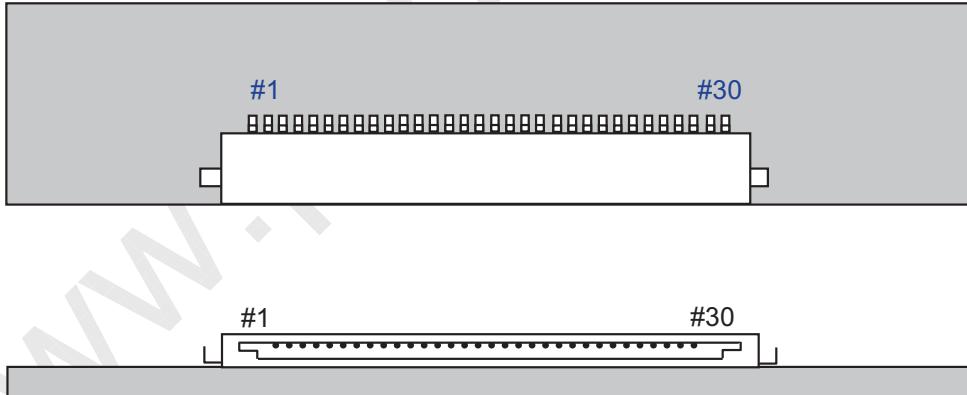
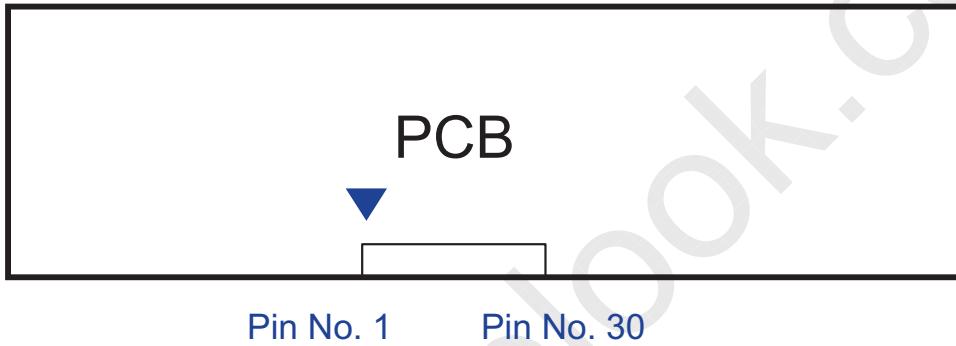


Fig. Connector diagram

- Power GND pins should be connected to the LCD's metal chassis.
- All power input pins should be connected together.
- All NC pin should be separated from other signal or power.

4.2. converter Input Pin Configuration

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Connector : Yeon-ho, 20022WS-H14J

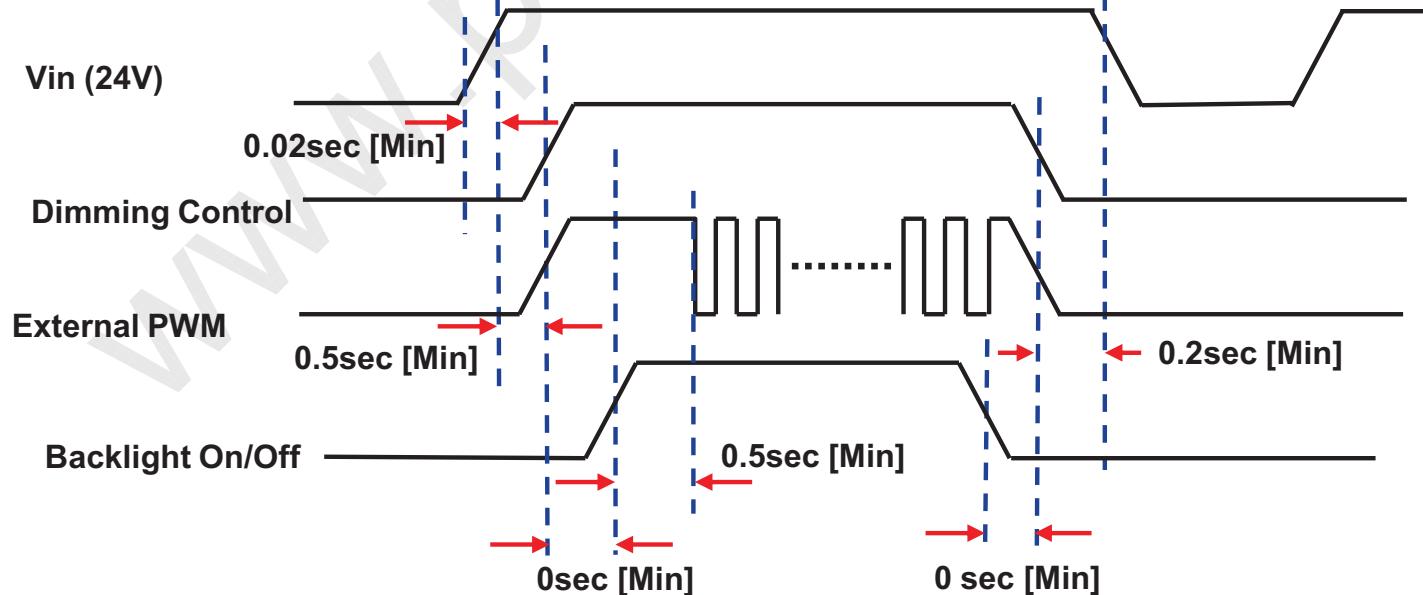
Pin No.	Pin Configuration(FUNCTION)	
	Master	
1		24 V
2		24 V
3		24 V
4	Pin No. 1	24 V
5		24 V
6		GND
7		GND
8		GND
9		GND
10		GND
11		No connection
12		ENA [converter on/off control signal] *Note(2)
13		Analog Dimming Control [0V:Min, 3.3V:Max] *Note(1)
14		External PWM [10~100%] *Note(1), Note(2)

Note(1) If use Dimming Control, Pin 14 Must be N.C

If use External PWM, Pin 13 Must be N.C

Note(2) Pin 12 has Pull down register 100Kohm, Pin 13/14 has Pull up register 100Kohm

4.3. converter Input Power Sequence



Note) SEQUENCE : ON = Vin(24V) > Dimming Control ≥ Backlight On/Off
OFF = Backlight On/Off ≥ Dimming Control > Vin(24V)

4.4 LVDS Interface

- LVDS Receiver : Tcon (merged)
- Data Format

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	LVDS pin	VESA (Normal)	JEIDA
TxOUT/RxIN0	TxIN/RxOUT0	R0	R4
	TxIN/RxOUT1	R1	R5
	TxIN/RxOUT2	R2	R6
	TxIN/RxOUT3	R3	R7
	TxIN/RxOUT4	R4	R8
	TxIN/RxOUT6	R5	R9
	TxIN/RxOUT7	G0	G4
TxOUT/RxIN1	TxIN/RxOUT8	G1	G5
	TxIN/RxOUT9	G2	G6
	TxIN/RxOUT12	G3	G7
	TxIN/RxOUT13	G4	G8
	TxIN/RxOUT14	G5	G9
	TxIN/RxOUT15	B2	B4
	TxIN/RxOUT18	B3	B5
TxOUT/RxIN2	TxIN/RxOUT19	B4	B6
	TxIN/RxOUT20	B5	B7
	TxIN/RxOUT21	B6	B8
	TxIN/RxOUT22	B7	B9
	TxIN/RxOUT24	Don't care	Don't care
	TxIN/RxOUT25	Don't care	Don't care
	TxIN/RxOUT26	DEN	DEN
TxOUT/RxIN3	TxIN/RxOUT27	R6	R2
	TxIN/RxOUT5	R7	R3
	TxIN/RxOUT10	G6	G2
	TxIN/RxOUT11	G7	G3
	TxIN/RxOUT16	B6	B2
	TxIN/RxOUT17	B7	B3
	TxIN/RxOUT23	RESERVED	RESERVED

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4.5 Input Signals, basic display colors and gray scale of each color

COLOR	DISPLAY (8bit)	DATA SIGNAL																						GRAY SCALE LEVEL		
		RED							GREEN							BLUE										
		R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7	
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-
	CYAN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	MAGENTA	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
GRAY SCALE OF RED	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0
	DARK ↑ ↓ LIGHT	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1
		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~R252	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R253	
		1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R254
		0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R255
GRAY SCALE OF GREEN	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0
	DARK ↑ ↓ LIGHT	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G1
		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3~G252	
		:	:	:	:	:	:	:	:	0	1	0	1	1	1	1	1	0	0	0	0	0	0	0	0	G253
		0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	0	0	0	0	0	0	0	0	G254
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G255
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0
	DARK ↑ ↓ LIGHT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	B1
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	B2	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	1	0	0	0	0	0	B3~B252	
		:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	B253	
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	B254	
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	B255

Note) Definition of Gray :

Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray (n = Gray level)

Input Signal : 0 = Low level voltage, 1 = High level voltage

5. Interface Timing

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5.1 Timing Parameters (DE mode)

SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	Unit	NOTE
Clock	Frequency	$1/T_C$	70	78	85	MHz	-
Hsync		F_H	44	48	53	KHz	-
Vsync		F_V	47	60	66	Hz	-
Vertical Display Term	Active Display Period	T_{VD}	-	768	-	Lines	-
	Vertical Total	T_V	780	802	1200	Lines	-
Horizontal Display Term	Active Display Period	T_{HD}	-	1366	-	Clocks	-
	Horizontal Total	T_H	1460	1624	2000	clocks	-

Note) This product is DE mode. But the Hsync & Vsync signal must be inputted

(1) Test Point : TTL control signal and CLK at LVDS Tx input terminal in system

(2) Internal VDD = 3.3V

(3) Spread spectrum

- Modulation rate (max) : $\pm 1.5\%$, Modulation Frequency : under 100KHz

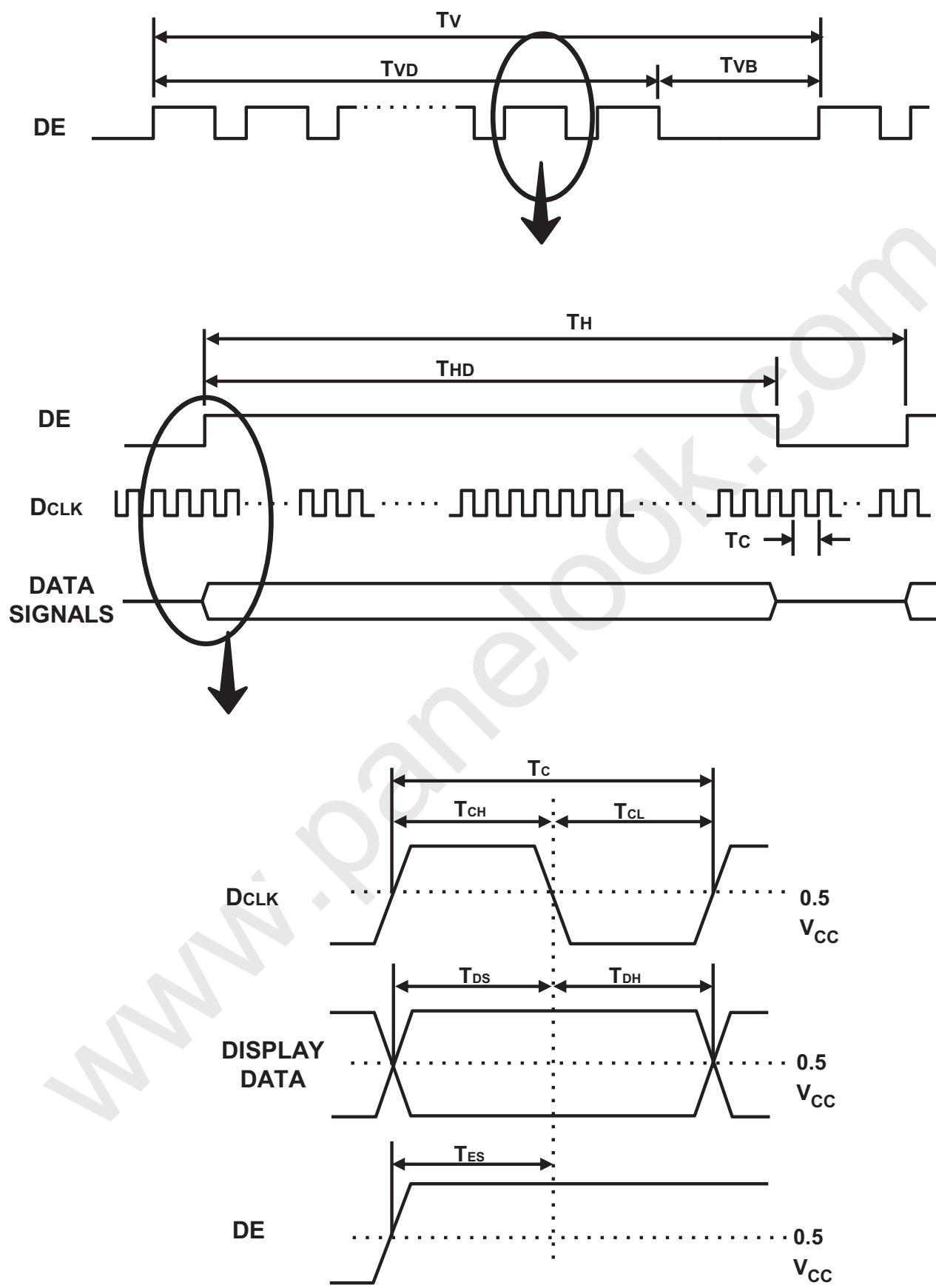
5.2 LVDS Input Data Characteristics

ITEM		SYMBOL	Min.	Typ.	Max.	UNIT	NOTE	
Input Data Position	$F_{IN}=85MHz$	t_{RSRM}	-	-	400	ps		
		t_{RSLM}	-400	-	-	ps		
Input common mode voltage		V_{CM}	$V_{SSL}+0.6$	1.2	$V_{DDL}-0.6$	V	-	
Differential Input Voltage		$ V_{ID} $	100	-	-	mV	-	

Note) When the skew is measured the Spread Spectrum should be 0%

5.3 Timing diagrams of interface signal (DE only mode)

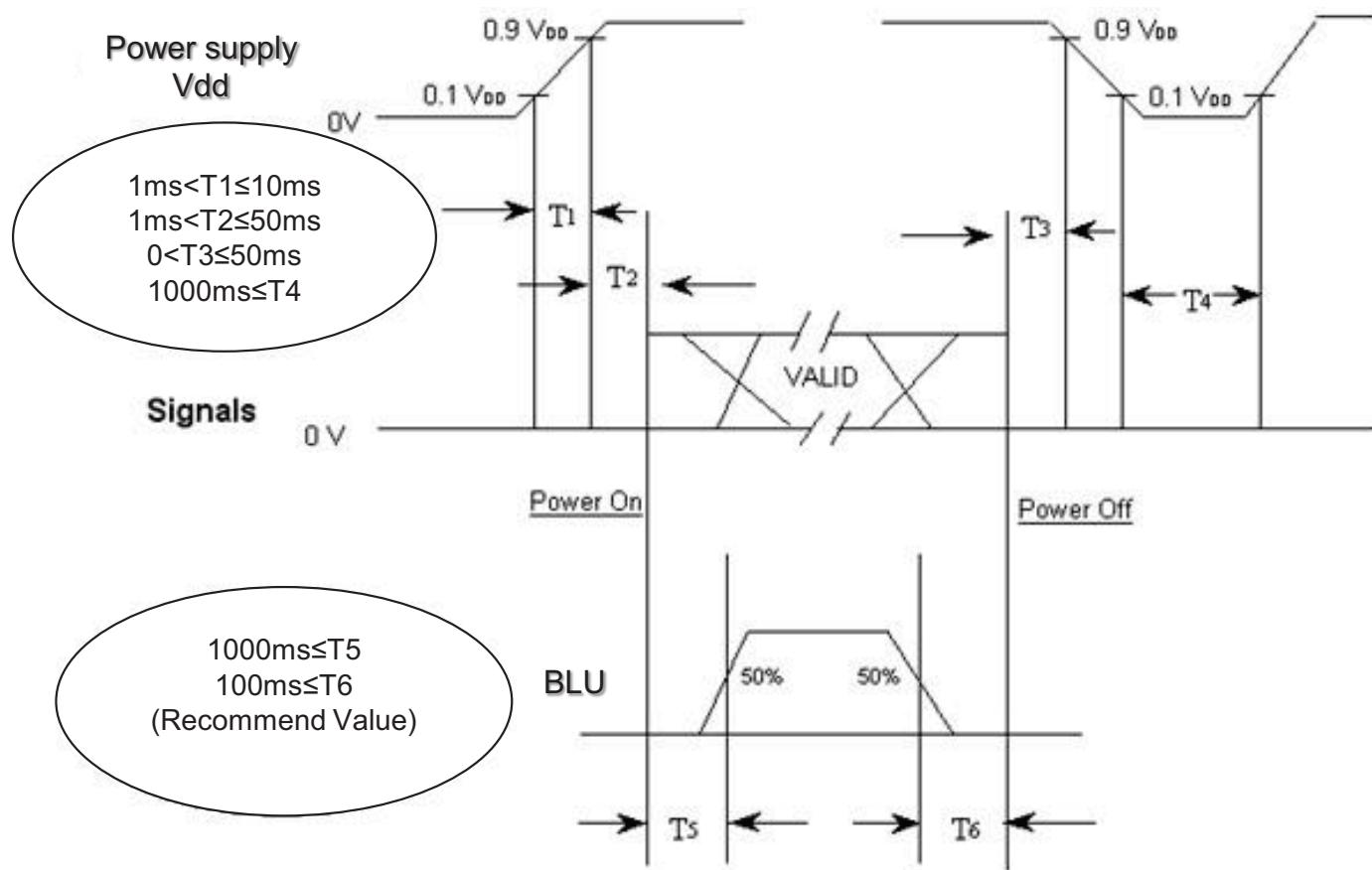
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5.4 Power ON/OFF Sequence

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To prevent a latch-up or DC operation of the LCD Module, the power on/off sequence should be as the diagram below.



T1 : V_{DD} rising time from 10% to 90%

T2 : The time from V_{DD} to valid data at power ON.

T3 : The time from valid data off to V_{DD} off at power Off.

T4 : V_{DD} off time for Windows restart

T5 : The time from valid data to B/L enable at power ON.

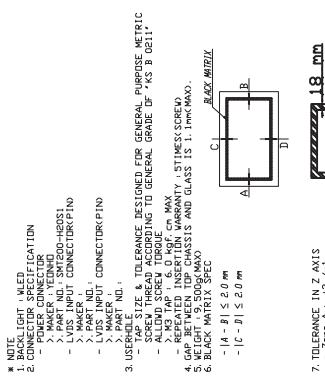
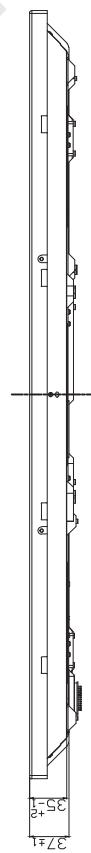
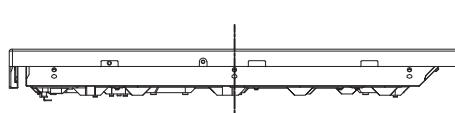
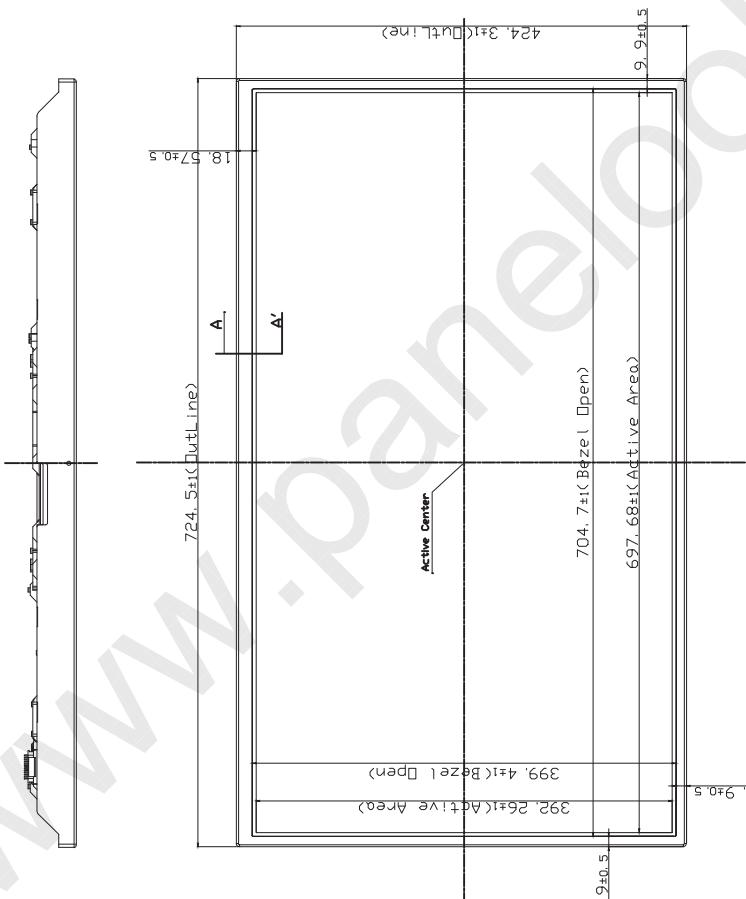
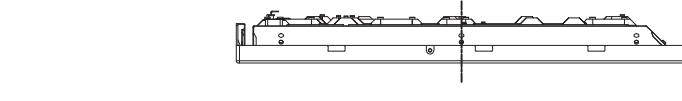
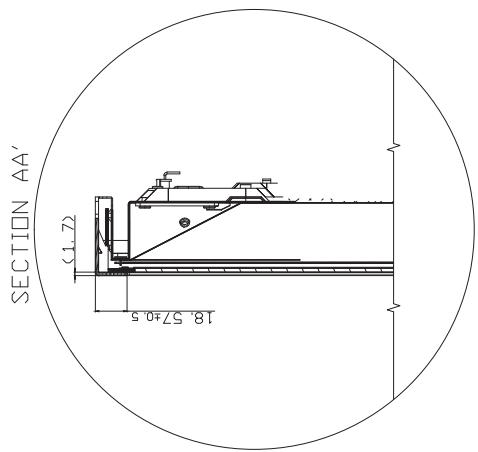
T6 : The time from valid data off to B/L disable at power Off.

- The supply voltage of the external system for the module input should be the same as the definition of V_{DD} .
- Apply the LED voltage within the LCD operation range. When the back light turns on before the LCD operation or the LCD turns off before the back light turns off, the display may momentarily show abnormal screen.
- In case of $V_{DD} = \text{off level}$, please keep the level of input signals low or keep a high impedance.
- T_4 should be measured after the module has been fully discharged between power off and on period.
- Interface signal should not be kept at high impedance when the power is on.
- In Case T_5 is less than 1000msec and T_6 is less than 100msec, garbage display can be seen. (It is not related to electrical function issue, just for recommendation to prevent garbage display)

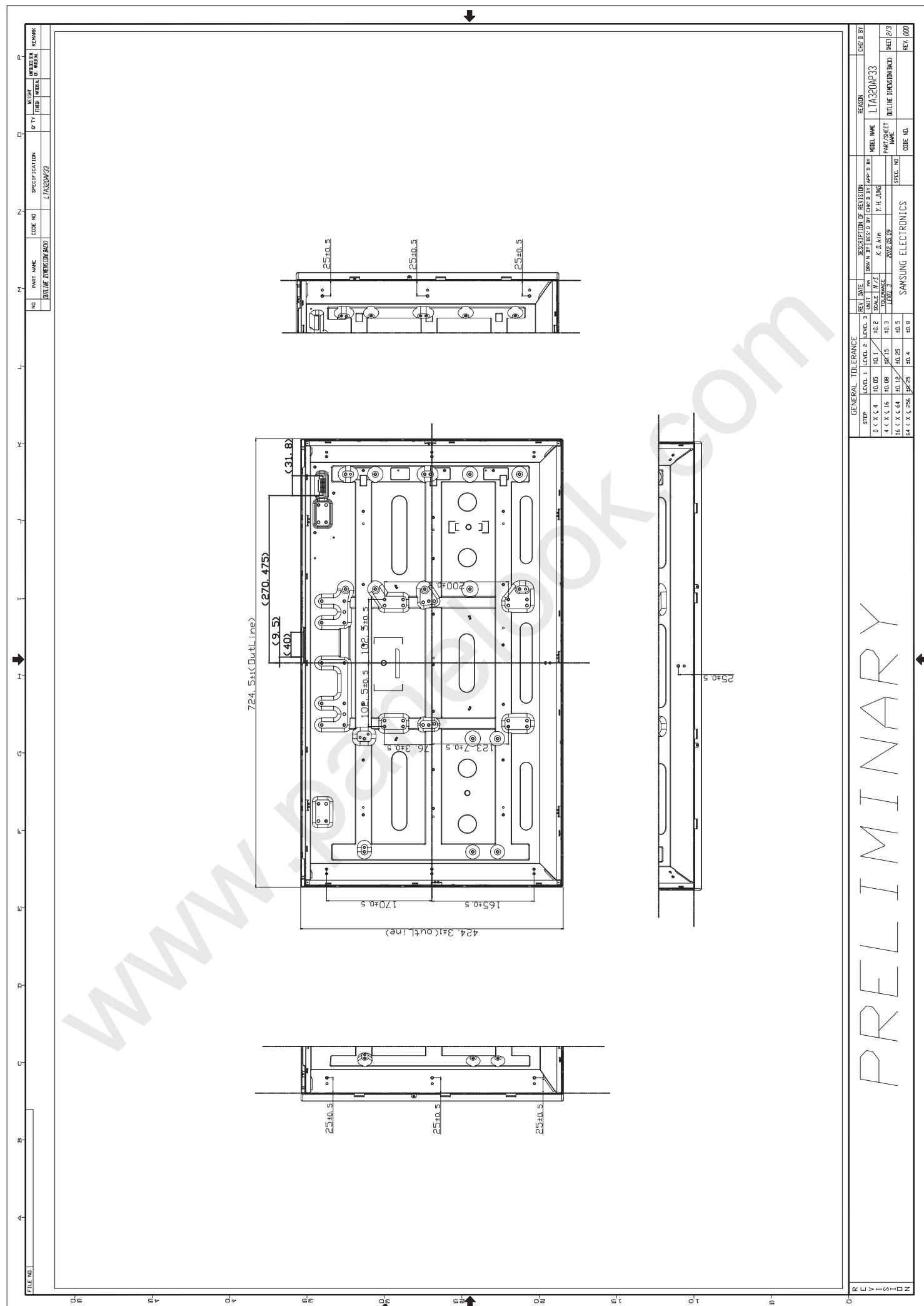
SECTION AA'

Diagram illustrating the cross-section of a bridge pier. The pier is shown in a circular cross-section, featuring a central vertical column and a horizontal top slab. A vertical dimension line indicates a height of 18.57 ± 0.5. A horizontal dimension line indicates a width of <1.72. The diagram includes a table of part numbers and descriptions:

Part No.	Part Name	Code No.	Specification	Qty	Notes
10110000000000000000	DOOR, DOME/DOOR	L143204PZ3		1	



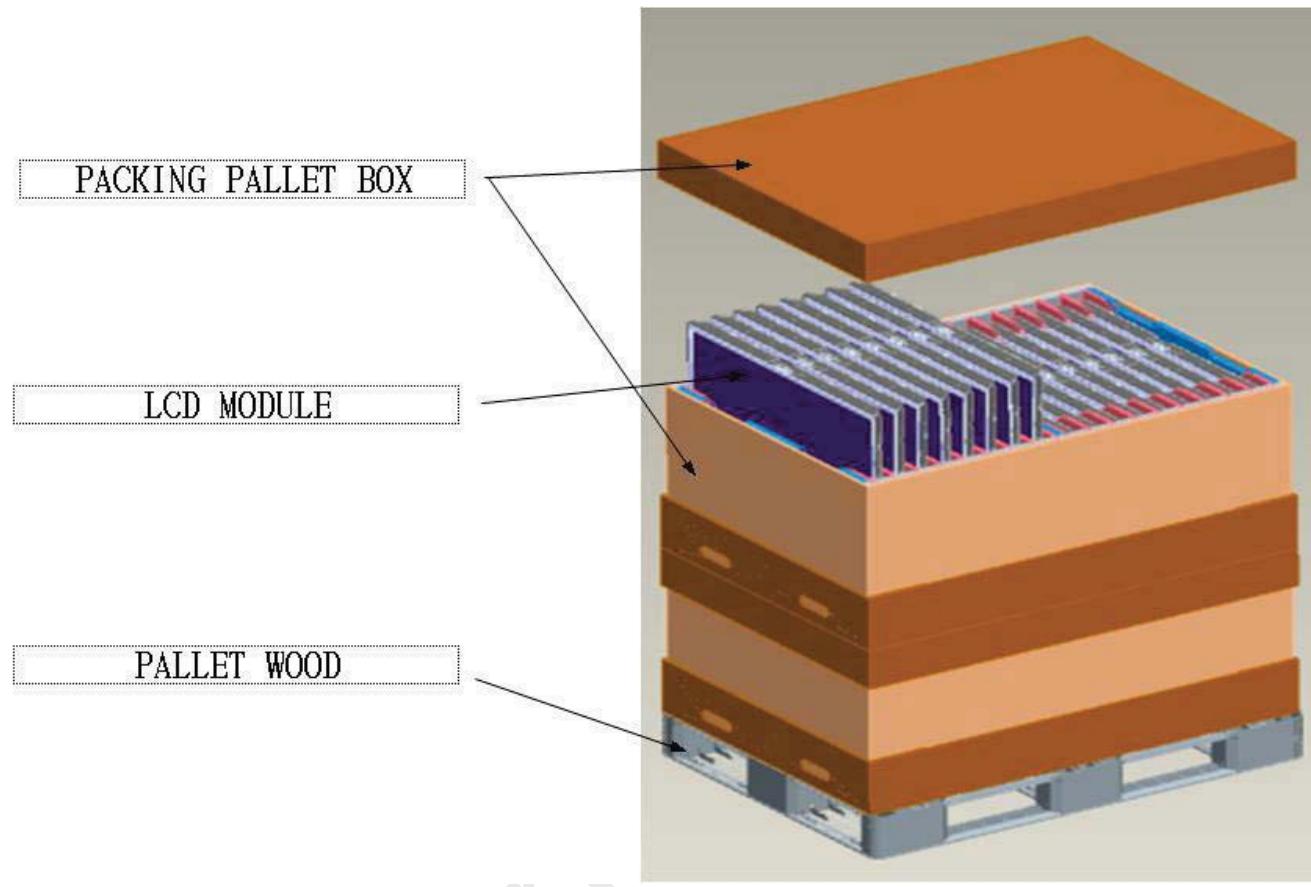
DICTIONARY



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7. PACKING

7.1 Carton (Internal Package)



7.2 Packing Specification

Item	Specification	Remark
LCD Packing	17ea / Box 34ea / Pallet (Packing-Pallet Box)	1. 4.5 Kg / LCD (34ea) : 153kg(Max) 2. 14.5Kg / Packing Box (1set) > Packing Box Material : Paper 3. 10 g/EA, 3 EA/Module, Cobalt-dichloride-free
Pallet	2Box / Pallet	1. Pallet weight = 4.8 kg > Pallet Material : HDPE
Packing Direction	Vertical	
Total Pallet Size	L x W x height	1150mm(L) x 850mm(W) x 1069mm(height)
Total Pallet Weight	187.82kg	Module (4.5*34) + Pallet (4.8kg) + Packing Set (14.5*2) + Desiccant (0.03*34) = 187.82kg

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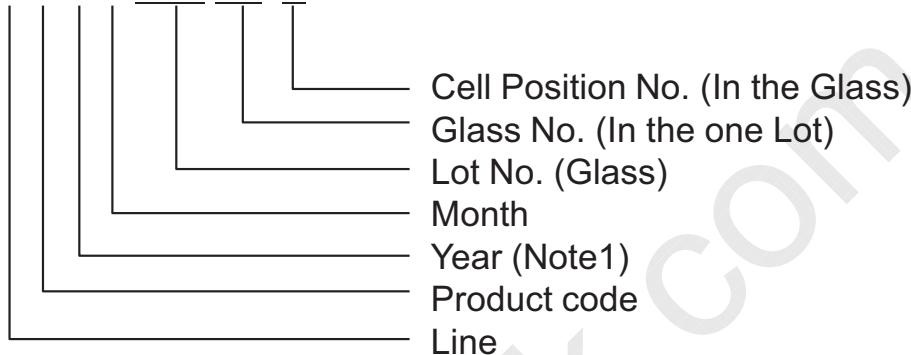
8. Marking & Others

A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.

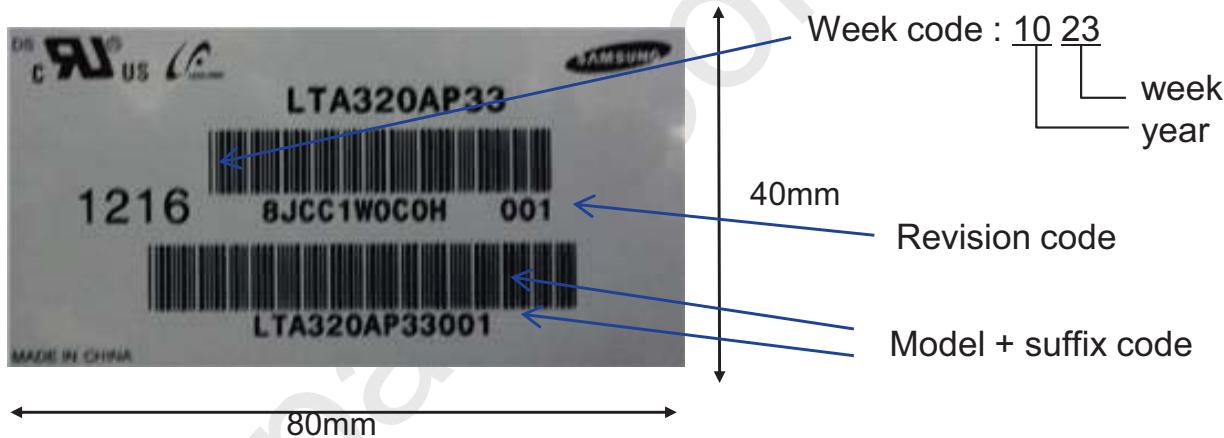
(1) Part number : LTA320AP33

(2) Revision: Three letters

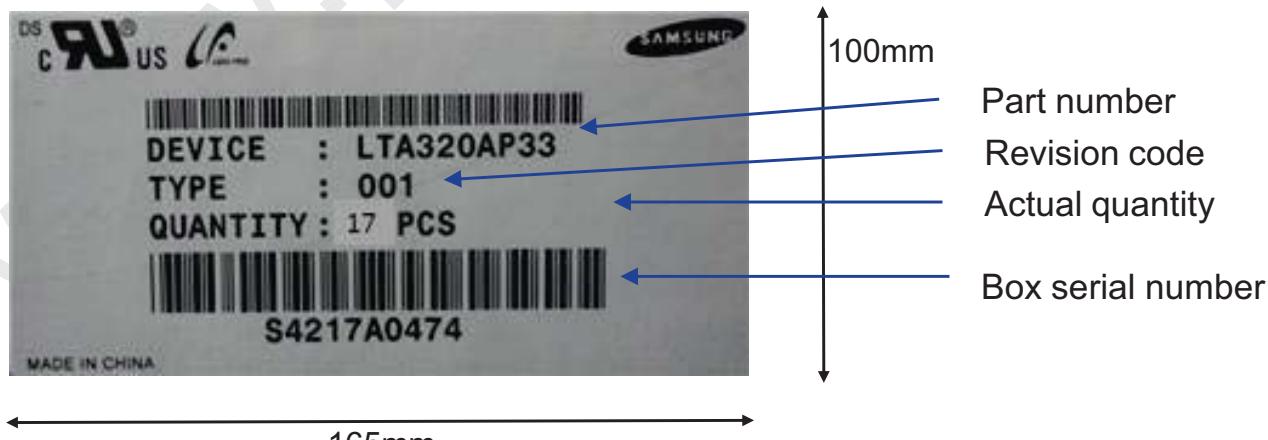
(3) Lot number : X X X X XXX XX X



(4) Nameplate Indication



(5) Packing box attach



(6) Others

1. After service part

LED bar can not be replaced because of the narrow bezel structure.

9. General Precautions

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9.1 Handling

- (a) When the module is assembled, it should be attached to the system firmly using all mounting holes. Be careful not to twist and bend them.
- (b) Module should be disconnected from power before it is assembled or disassembled.
- (c) Refrain from strong mechanical shock and / or any force to the module. In addition to damage, this may cause improper operation or damage to the module and LED back light.
- (d) Note that polarizers are very fragile and could be damage easily. Do not press or scratch the surface harder than a HB pencil lead.
- (e) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, staining or discoloration may occur.
- (f) If the surface of the polarizer is dirty, clean it using absorbent cotton or soft cloth.
- (g) Desirable cleaners are water, IPA(Isopropyl Alcohol) or Hexane. Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might do permanent damage to the polarizer due to chemical reaction.
- (h) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth . In case of contact with hands, legs or clothes, it must be washed away with soap thoroughly.
- (i) Protect the module from ESD (Electro-Static Discharge). Otherwise the ASIC IC or semiconductor would be damaged.
- (j) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (k) Do not disassemble the module.
- (l) Do not disassemble shield case of LVDS board
- (m) Do not connect N.C pins. (Samsung internal use only)
- (n) Protection film for polarizer on the module should be slowly peeled off just before use so that the electrostatic charge can be minimized. Must put on antistatic glove while handling a module
- (o) Pins of Interface connector should not be touched directly with bare hands.

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9.2 Package storage

We highly recommend to comply with the criteria in the table below.

ITEM	UNIT	Min.	Max.
Storage Temperature	(°C)	5	40
Storage Humidity	(%rH)	35	75
Storage Life	12 months		
Storage Condition	<ul style="list-style-type: none"> - The storage room should provide good ventilation and temperature control. - Products should not be placed on the floor, but on the Pallet away from a wall. - Prevent products from direct sunlight, moisture nor water; Be cautious of a build up of condensation. - Avoid other hazardous environment while storing goods. - If products delivered or kept in conditions of over the storage period of 3months, the recommended temperature or humidity range, we recommend you leave them at a temperature of 20 °C and a humidity of 50% for 24 hours. 		

9.3 Operation

- (a) Do not connect or disconnect the Module in the "Power On" condition.
- (b) Power supply should always be turned on/off by the "Power on/off sequence"
- (c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference should be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- (d) The cable between the back light connector and its Converter power supply should be connected directly with a minimized length. A longer cable between the back light and the Converter may cause lower luminance of lamp(LED) and may require higher startup voltage(Vs).

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9.4 Operation Condition Guide

(a) The LCD product should be operated under normal conditions.

Normal condition is defined as below;

- Temperature : $20 \pm 15^{\circ}\text{C}$
- Humidity : $55 \pm 20\%$
- Display pattern : continually changing pattern (not stationary)

(b) If the product will be used in extreme conditions such as high temperature, humidity, display patterns or operation time etc..., It is strongly recommended to contact SEC for application engineering advice. Otherwise, its reliability and function may not be guaranteed. Extreme conditions are commonly found at airports, transit stations, banks, stock market, and controlling systems.

9.5 Others

(a) Ultra-violet ray filter is necessary for outdoor operation.

(b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.

(c) Do not exceed the absolute maximum rating value. (supply voltage variation, variation in part contents and environmental temperature and so on)
Otherwise the module may be damaged.

(d) If the module keeps displaying the same pattern for a long period of time, the image may be "sticked" to the screen.

To avoid image sticking, it is recommended to use a screen saver.

(e) This Module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.

(f) Please contact SEC in advance when you display the same pattern for a long time.

(g) Be cautious for detergents or water not to be permeated into the gap between the module and the panel when placing the module upside down.